26th.—Ariz., Cal., Colo., Dak., Ill., Ind., Ind. T., Iowa., Kans., Me., Mass., Mich., Mont., Nebr., Nev., N. H., N. J., N. Y., Ohio, Oregon, Pa., Tenn., Vt., Wis., Wyo.

27th.—Ariz., Cal., Colo., Dak., Ill., Ind. T., Iowa, Kans., Me., Mass., Mich., Minn., Mo., Nebr., Nev., N. Mex., N. C., Ohio, Oregon, Pa., Tenn., Tex., Vt., Wis., Wyo.

28th.—Ariz., Ark. (Fort Smith), Cal., Colo., Dak., Ill., Ind., Ind. T., Iowa, Kans., Mich., Nev., N. Mex., N. Y., Ohio, Oregon, Pa., Tenn., Tex., Wis., Wyo.

29th.—Ariz., Ark. (Lead Hill), Cal., Colo., Dak., Ill., Ind. T., Iowa, Kans., Me., Mass., Mich., Minn., Mo., Mont., Nebr., Nev., N. H., N. Mex., Ohio, Oregon, Pa., Tenn., Tex., Vt., Wis., Wyo.

30th.—Ariz., Ark. (Lead Hill and Little Rock), Cal., Colo., Dak., Ill., Ind., Ind. T., Iowa, Kans., Mass., Mich., Minn., Miss. (Vicksburg), Mo., Mont., Nebr., Nev., N. H., N. Mex., N. Y., Ohio, Oregon, Pa., Tenn., Tex., Vt., Wash., W. Va., Wis.

31st.—Ala. (Livingston, Mobile, and Montgomery), Ariz., Ark. (Lead Hill), Cal., Dak., Fla., (Archer, Jacksonville, Pensacola, and Tallahassee), Ga., (Atlanta, Quitman, and Savannah), Ill., Ind., Ind. T., Iowa, Kans., Ky., La., (Shreveport), Me., Md., Mass., Mich., Minn., Miss. (Biloxi, University, and Vicksburg), Mo., Mont., Nebr., Nev., N. H., N. J., N. Mex., Ohio, Oregon, Pa., Tenn., Tex., Vt., Va., Wash., W. Va., Wis., Wyo.

ICE.

The formation of ice in the southern parts of the country occurred on the following dates:

Ashwood, Tenn., 13th, 22d; Austin, Tenn., 15th, 23d; Charlotte, N. C., 16th; Prescott, Ariz., 20th; Nashville, Tenn., 22d, 31st; Milan, Tenn., 30th, 31st; Quitman and Atlanta, Ga., University of Mississippi, Miss., and Chattanooga, Tenn., 31st.

TEMPERATURE OF WATER.

The following table shows the maximum, minimum, and mean water temperature, as observed at the harbors of the several stations; the monthly range of water temperature; the average depth at which the observations were made, and the mean temperature of the air:

Temperature of water for October, 1887.

Station.	Temperature at bottom.				Mean temperature of air at the station.	Average depth of water in tenths and hundre'ths
	Max.	Min.	Range.	Monthly mean.		
	°	°	°	°	°	
Canby, Fort, Wash	58.1	50.1	8.0	54.3	14.8	53.2
Cedar Keys, Fla.						
Charleston, S. C	75.0	63.3	11.7	70.0	66.0	36.8
Eastport, Me	51,6	48.5	3.1	50.3	46.4	16.5
Galveston, Tex	80.4	58.4	22.0	70.5	69.4	15.1
Key West, Fla	86.0	72.4	13.6	81.6	78.9	20.3
New London, Conn	63.1	54.2	8.9	59.7	53.1	12.2
New York City	62.8	52.9	9.9	58.8	54.7	14.9
Pensacola, Fla	77.6	65.6	12.0	73.0	68.2	17.9
Portland, Me	54.4	47.1	7.3	51.1	47.6	16.5
Portland, Oregon	61.0	51.2	9.8	56.3	53.8	52.9

PRECIPITATION (expressed in inches and hundredths).

The distribution of precipitation over the United States and Canada for October, 1887, as determined from the reports of about eight hundred stations, is exhibited on chart iv. In the table of miscellaneous meteorological data are given, for each Signal Service station, the total precipitation, with the departures from the normal. The figures opposite the names of the geographical districts in columns for mean temperature, precipitation, and departures from the normal, show respectively the averages for the several districts. The normal for any district may be found by adding the departure to the current mean when the precipitation is below the normal, and subtracting when above.

The precipitation over the greater part of the United States, as compared with the normal, is deficient. The districts where an excess is shown are: Eastern Montana and adjacent portions of Dakota; southern Colorado and northern New Mexico; southeastern Kansas, Indian Territory, and central-northern Texas; the lower Rio Grande Valley; the eastern Gulf and south Atlantic states, except northern Florida; and over the Gulf of Saint Lawrence. An excess of more than one inch over the average precipitation for October occurs in the south Atlantic states. The precipitation in the southern portions of Louisiana and Mississippi is very heavy, the excess at New Orleans amounting to 1.54, and at voluntary stations in southern Mississippi the rainfall is more than double the amount which fell at New Orleans. Over an area extending from southeastern Kansas to central Texas, and in the lower Rio Grande valley, the monthly rainfalls are also exceptionally heavy, the excess at several stations in the regions named amounting to more than two inches. At Brownsville, Tex., the monthly rainfall is 16.27, nearly twelve inches in excess of the October average for the eleven preceding years.

As previously stated, the area of deficiency is much greater than that of excessive rainfall. On the Pacific coast, in the northern and middle plateau districts, and over the entire region from the Missouri and central Mississippi valleys eastward to the Atlantic coast, the rainfall is decidedly below the average. The precipitation in New England and the lower lake region is about 65 per cent. of the normal, while in the Ohio and upper Mississippi valleys it is less than 50 per cent. Over a large part of California there was an almost entire absence of rainfall during the month, the October average of former years in the northern part of the state being slightly more than an inch, and that for the southern part of the state about four-tenths of an inch. While a deficiency of nearly one inch is shown for the north Pacific coast region (the normal being about 4.50), in the extreme northwestern part of Washington Territory the rainfall is very heavy, Tatoosh Island and Neah Bay reporting 11.83 and 14.84, respectively. This area of heavy rainfall, however, extends but a short distance inland from the coast, as shown by reports from neighboring stations. At Port Angeles, about fifty miles east of Neah Bay, the rainfall is less than three inches, and at Olympia it is but 1.51.

The following are some of the most marked departures from normal precipitation as reported from Signal Service stations:

Above normal.		Below normal.	
	Inches.		*Inches.*
Brownsville, Tex	11.63	Jacksonville, Fla	4.42
Charlotte, N. C	4.75	Springfield, Ill	3.27
Tatoosh Island, Wash	4.67	Portland, Oregon	3.19
Hatteras, N. C	4.55	Des Moines, Iowa	3.03
Augusta, Ga	4.45	Cedar Keys, Fla	2.95
Key West, Fla	3.91	Louisville, Ky	2.93
Fort Gibson, Ind. T	3.30	Cincinnati, Ohio	2.91
Cape Henry, Va	2.86	Olympia, Wash	2.54
Norfolk, Va	2.84	Fort Elliott, Tex	2.44
Abilene, Tex	2.35	Omaha, Nebr	2.32

DEVIATIONS FROM AVERAGE PRECIPITATION.

The following table shows for certain stations, as reported by voluntary observers, (1) the average precipitation for a series of years; (2) the length of record during which the observations have been taken, and from which the average has been computed; (3) the total precipitation for October, 1887; (4) the departures of the current month from the average; (5) and the extreme monthly precipitation for October during the period of observations and the year of occurrence:

Deviations from average precipitation.

State and station.	County.	(1) Average for the month of October.	(2) Length of record.	(3) Total for October, 1887.	(4) Departure from average.	(4) Extreme monthly precipitation for October. Greatest. Am't.	Greatest. Year.	Least. Am't.	Least. Year.
Arkansas.		*Inches*	*Years*	*Inches*	*Inches.*	*Inches*		*Inches.*	
Lead Hill	Boone	5.63	6	1.50	—4.13	18.11	1883	0.10	1886
California.									
Sacramento	Sacramento	0.73	21	0.00	—0.73				
Connecticut.									
Canton	Hartford	4.91	26	2.90	—2.01				
Hatrford	Hartford	3.23	16	2.50	—0.73				
Middletown	Middlesex	3.86	29	3.32	—0.54				
Wallingford	New Haven	3.98	29	3.25	—0.73				
Florida.									
Archer	Alachua	2.33	5	1.19	—1.14				
Illinois.									
Aurora	Kane	3.88	9	3.54	—0.34				
Golconda	Pope	4.02	9	0.64	—3.38				
Mattoon	Coles	4.38	8	0.97	—3.41				
Oswego	Kendall	3.90	7	1.95	—1.95				
Peoria	Peoria	2.57	32	2.14	—0.43				
Riley	McHenry	2.61	28	2.75	+0.14				
Sycamore	De Kalb	4.96	7	2.80	—2.16				
Indiana.									
Blue Lick	Clark	2.92	10	0.60	—2.32	7.16	1883	0.60	1887
Connersville	Fayette	2.49	6	0.63	—1.86	6.51	1883	0.63	1887
Lafayette	Tippecanoe	2.85	8	1.62	—1.23	5.56	1883	0.70	1886
Logansport	Cass	2.70	33	1.90	—0.80	6.98	1877	1.00	1874
Mauzy	Rush	2.88	8	0.61	—2.27	7.88	1883	0.61	1887
Sunman	Ripley	2.27	5	0.74	—1.53	5.75	1883	0.74	1887
Vevay	Switzerland	2.65	21	0.67	—1.98	7.07	1883	0.28	1879
Worthington	Greene	3.06	6	1.13	—1.93	9.53	1883	0.28	1879
Iowa.									
Cresco	Howard	2.56	14	1.53	—1.03				
Kansas.									
Independence	Montgomery	2.94	15	2.61	—0.33				
Lawrence	Douglas	2.88	20	3.83	+0.95	6.96	1870	0.44	1878
Wellington	Sunman	3.72	9	6.06	+2.34				
Yates Centre	Woodson	3.49	7	1.91	—1.58	8.52	1881	1.16	1886
Maine.									
Cornish	York	4.00	30	2.04	—1.96				
Gardiner	Kennebec	4.45	49	2.44	—2.01				
Lewiston	Androscoggin	4.01	13	2.42	—1.59				
Orono	Penobscot	4.42	19	3.00	—1.42				
Maryland.									
Fallston	Harford	3.38	17	1.37	—2.01	7.56	1873	0.23	1874
Massachusetts.									
Amherst	Hampshire	3.74	53	2.21	—1.53				
Cambridge	Middlesex	3.39	47	3.36	—0.03				
Chestnut Hill	Middlesex	3.73	12	3.21	—0.52				
Framingham	Middlesex	3.86	13	2.87	—0.99				
Lake Cochituate	Middlesex	4.12	36	2.49	—1.63				
Ludlow	Hampden	3.09	12	2.05	—1.04				
Lynn	Essex	3.64	13	2.92	—0.72				
Mystic Lake	Middlesex	3.45	12	3.06	—0.39				
New Bedford	Bristol	3.81	75	3.95	+0.14				
Somerset	Bristol	3.85	17	2.64	—1.21				
Springfield	Hamden	4.11	40	1.96	—2.15				
Waltham	Middlesex	3.65	63	2.91	—0.74				
Nevada.									
Carson City	Ormsby	0.41	9	0.04	—0.37				
New Brunswick.									
Saint Johns	Saint Johns	4.60	27	3.70	—0.90				
New Hampshire.									
Concord	Merrimac	3.80	32	1.71	—2.09				
Hanover	Grafton	2.73	23	1.89	—0.84				
New Jersey.									
Dover	Morris	3.88	5	1.99	—1.89				
South Orange	Essex	3.39	18	1.90	—1.49				
New York.									
Factoryville	Tioga	2.45	6	2.11	—0.34				
Humphrey	Cattaraugus	3.24	4	3.96	+0.72	4.17	1885	1.55	1886
Palermo	Oswego	3.47	34	1.93	—1.54	7.90	1862	0.30	1882
Ohio.									
North Lewisburg	Champaign	2.28	16	0.45	—1.83				
Wauseon	Fulton	2.95	15	1.97	—0.98	8.92	1881	0.93	1874
Pennsylvania.									
Dyberry	Wayne	3.06	17	1.24	—1.82				
South Carolina.									
Kirkwood	Kershaw	2.47	20	7.23	+4.76	14.75	1878	0.04	1884
Stateburg	Sumter	3.08	7	8.15	+5.07	3.52	1885	0.02	1884
Texas.									
New Ulm	Austin	4.04	16	2.70	—1.34	12.44	1881	0.79	1874
Vermont.									
Lunenburg	Essex	3.61	38	2.39	—1.22				
Newport	Orleans	3.92	12	1.83	—2.09				
Strafford	Orange	3.98	13	2.87	—1.11	5.30	1877	1.20	1882
Virginia.									
Bird's Nest	Northampton	3.09	19	1.27	—1.82				
Dale Enterprise	Rockingham	2.05	7	1.55	—0.50	12.63	1885	0.96	1884
Variety Mills	Nelson	3.54	8	3.30	—0.24	10.76	1885	0.96	1884
Wytheville	Wythe	2.95	23	3.46	+0.51				
West Virginia.									
Helvetia	Randolph	3.26	11	1.20	—2.06	5.80	1885	1.30	1885

EXCESSIVE MONTHLY PRECIPITATION FOR OCTOBER.

With a view to the arrangement of the rainfall data of this office in such a manner as would best tend to the interests and add to the information of the engineers of the country and other classes interested in extreme rainfalls, there has been collated for the month of October for a series of years (for the most part ranging from ten to sixteen) data showing the greatest rainfall that has occurred in any October; cases in which 2.50 inches of rain have fallen in twenty-four hours, and also instances where the rain has been so excessive as to equal or exceed the rate of an inch per hour. These data apply only to extreme cases in October, and while they give a general idea of extreme amounts of precipitation for month, day, and short periods of time, yet the lack of rainfall stations and long records prevent the data from being entirely exhaustive.

It is found that rainfalls exceeding ten inches have occurred in October at various points contiguous to the sea coast of New England and at scattered points throughout the whole extent of the south Atlantic and Gulf states, as well as on the Pacific coast northward of the fortieth parallel. In central Illinois and northern Arkansas, amounts exceeding ten inches have also fallen.

The following table shows for October all monthly rainfalls exceeding ten inches, as well as the maximum amount fallen, at any station in the various states and territories:

State or territory.	Station.	Amt.	Year.	State or territory.	Station.	Amt.	Year.
Alabama	Montgomery	10.20	1879	Montana	Fort Maginnis	4.06	1883
Do	Greensborough	9.85	1879	Nebraska	Omaha	5.86	1877
Do	Green Springs	9.85	1879	Nevada	Fort McDermit	6.33	1883
Arizona	Fort Apache	4.68	1880	N. Hampshire	Mt. Washington	18.38	1881
Arkansas	Lead Hill	18.11	1883	Do	do	12.91	1884
California	Fort Gaston	12.50	1876	Do	do	11.11	1885
Do	do	9.02	1882	Do	Weir's Bridge	11.80	1869
Colorado	Pike's Peak	4.64	1880	Do	Lake Village	11.54	1869
Connecticut	New Haven	10.09	1887	New Jersey	Orange	7.19	1887
Dakota	Webster	9.39	1882	New Mexico	Santa Fé	4.19	1881
Dis. of Colum.	Washington City	8.69	1885	New York	Rochester	8.67	1873
Florida	Key West	9.27	1876	N. Carolina	Salisbury	14.19	1887
Do	do	14.20	1879	Do	Weldon	9.97	1887
Do	do	19.77	1883	Do	Hatteras	9.99	1878
Do	Jacksonville	9.45	1879	Do	do	12.00	1880
Do	do	16.25	1880	Do	do	10.28	1885
Do	do	10.30	1882	Do	do	11.07	1887
Do	Cedar Keys	10.37	1880	Do	Raleigh	10.23	1887
Do	Merritt's Island	11.30	1879	Do	Chapel Hill	11.21	1887
Do	do	11.82	1883	Do	Lumberton	9.51	1887
Georgia	Savannah	9.45	1878	Ohio	Wauseon	8.92	1881
Do	Leo	10.05	1879	Oregon	Astoria	13.40	1875
Do	Raburn Gap	19.40	1879	Do	do	14.20	1876
Do	Ellerslie	10.50	1885	Do	Portland	10.53	1876
Idaho	Boisé City	4.06	1883	Do	do	11.63	1882
Illinois	Springfield	10.02	1881	Pennsylvania	Erie	8.17	1885
Do	Mattoon	11.25	1881	Rhode Island	Narragansett Pier	8.14	1883
Do	do	9.40	1883	S. Carolina	Cheraw	10.11	1887
Do	McLeansborough	9.28	1883	Do	Charleston	14.32	1876
Do	Greenville	9.52	1883	Tennessee	Memphis	8.56	1883
Indiana	Indianapolis	8.56	1883	Texas	Brownsville	15.71	1884
Indian Ter	Fort Gibson	8.30	1877	Do	do	16.27	1887
Iowa	Keokuk	8.01	1881	Do	Galveston	17.78	1871
Kansas	Atchison	9.20	1870	Do	do	17.39	1877
Kentucky	Louisville	8.05	1883	Do	do	10.83	1881
Louisiana	Shreveport	9.30	1877	Do	Palestine	9.96	1882
Do	Point Pleasant	13.04	1880	Do	New Ulm	11.31	1877
Do	do	13.69	1881	Do	do	12.44	1881
Maine	Gardiner	13.15	1855	Utah	Salt Lake City	3.27	1876
Do	do	12.67	1869	Vermont	Croftsbury	10.72	1869
Maryland	Woodstock	8.23	1885	Virginia	Norfolk	11.36	1872
Mas'achusetts	Worcester	9.81	1869	Do	Variety Mills	10.76	1885
Michigan	Alpena	13.18	1877	WashingtonT.	Tatoosh Island	9.03	1884
Do	do	10.25	1881	Do	do	11.83	1887
Minnesota	Saint Vincent	6.61	1878	Do	Neah Bay	14.84	1887
Mississippi	Natchez	12.43	1877	W. Virginia	Helvetia	5.80	1885
Do	Vicksburg	9.69	1881	Wisconsin	Madison	9.12	1881
Do	Hazlehurst	10.20	1887	Wyoming	Fort Laramie	3.14	1874
Missouri	Saint Louis	7.51	1885				

It has also been found from examination of records that rains of 2.50 inches and upwards in twenty-four hours in the month of October during any year since the commencement of reports have fallen as follows:

At various points in New England, especially in the coast regions, at Mount Washington, and in and near the Connecticut Valley; in the middle Atlantic states adjacent to the coasts, in the valleys, along the rivers, and on the western shore of Chesapeake Bay; on the coasts of the south Atlantic states, near the rivers and in adjacent valleys, on the mountain slope in western North Carolina, and in southwestern Georgia; in northern and eastern Florida and at Key West; in the Gulf States, especially on the coasts, and in Louisiana, also in numerous places inland on and adjacent to rivers; near the mouth of the Rio Grande; on the Pacific coast northward of the fortieth parallel; inland at points on or near the Mississippi River, from Memphis, Tenn., northward to the southern border of Wisconsin; in the Ohio Valley and Tennes-

see, especially adjacent to rivers; along and near the western tributaries of the Mississippi east of the one hundredth meridian, and from the west Gulf states northward to Omaha, Nebr; in the valley of the Red River of the North; at Chicago, Ill., and in southern Michigan peninsula; on the southwestern shore of Lake Erie, and at Buffalo, N. Y.; also at three stations near the one hundred and fifth meridian, viz., Deadwood, Dak., Pike's Peak, Colo., and Fort Davis, Tex.

The following table shows the amount of excessive rainfall, at the rate of one inch or more per hour, during the month of October at any station during the years stated:

Year.	State.	Place.	Date.	Duration. Hours.	Duration. Minutes.	Total amount.	Rate per hour.
						Inches.	*Inches.*
1880..	Illinois	Springfield	25	0	06	0.23	2.30
	Nebraska	Howard	13	0	50	1.38	1.65
1881..	Texas	Brackettville	2	8	00	10.97	1.37
	Kansas	Fort Scott	2	0	20	1.80	5.40
	Indiana	Vevay	4	0	40	1.20	1.80
	Illinois	Swanwick	6	1	45	2.25	1.28
1882..	Missouri	Pro Tem	2	1	35	1.50	0.98
	Texas	San Antonio	8	1	10	1.70	1.45
	Alabama	Mobile	31	5	00	5.20	1.04
1883..	Kansas	Holton	1	1	05	2.50	2.30
1887..	Florida	Titusville	19–20	3	12	3.92	1.22
	Texas	Abilene	7–8	2	39	2.39	0.90

Table of excessive and greatest monthly precipitation for October, 1887.

Station.	Specially heavy. Date.	Amount.	Duration.	Largest monthly. Am't.
Alabama.			*h. m.*	
Marion	17 to 19	5.24	.....	7.70
Livingston	17 to 19	4.62	.....	.....
Mount Vernon	19	3.92	.....	.....
Decatur	17 to 18	2.09	.....	.....
Greenville	19	2.00	.....	.....
Opelika	19, 20	2.05	.....	.....
Mobile	19, 20	2.08	13 18	.....
Tuscumbia	24	2.00	.....	.....
Valley Head	23	2.00	.....	.....
Gadsden	20	2.50	.....	.....
Florence	25	4.00	.....	.....
Demopolis	19	2.00	.....	.....
Bermuda	19	3.09	.....	.....
Oswichee	24	2.00	.....	.....
Arkansas.				
Fort Smith	9	2.70	.....	.....
British Columbia.				
New Westminst'r	27, 28	3.66	.....	6.09
Florida.				
Titusville	19, 20	3.92	3 12	12.17
Key West	.....	.....	.....	9.40
Merritt's Island	.....	.....	.....	8.19
Alva	12, 13, 14	3.25	.....	6.00
Pensacola	25	2.32	8 00	.....
Saint Augustine	15	3.20	.....	.....
Georgia.				
Millen	20	2.15	.....	8.70
Do	26 to 28	6.20	.....	.....
Bainbridge Isl'nd.	27, 28	6.00	.....	7.50
Camak	.....	.....	.....	6.84
Augusta	.....	.....	.....	6.58
Smithville	20	2.80	.....	6.20
Do	26, 27	2.00	.....	.....
Forsyth	19, 20	2.10	16 00	.....
Milledgeville	19, 20	2.05	.....	.....
Macon	25 to 27	3.25	.....	.....
Albany	20	2.20	.....	.....
Do	27	2.00	.....	.....
Alapaha	27 to 29	3.31	.....	.....
Fort Gaines	19, 20	3.00	.....	.....
Thomasville	28, 29	2.90	.....	.....
Union Point	26	4.00	.....	.....
Waynesborough	26 to 28	3.00	.....	.....
Indian Territory.				
Fort Sill	7, 8	4.14	23 35	6.20
Fort Reno	7, 8	5.65	25 00	6.01
Eufaula	9, 10	2.45	.....	.....
Kansas.				
Wellington	7, 8	6.02	8 00	6.06
Globe	7 to 9	3.22	.....	.....
Lebo	8	2.26	.....	.....
Topeka	8	2.92	.....	.....
Independence	7, 8	2.24	33 00	.....
Louisiana.				
Amité City	19	3.65	.....	.....
Port Gibson	18	2.99	.....	.....
Natchitoches	24, 25	4.60	.....	.....
Minden	24	2.48	.....	.....
Lafayette	18, 19	4.13	.....	.....
Louisiana—Con.				
Coushatta	24, 25	3.05	.....	.....
Monroe	24	2.56	.....	.....
New Orleans	18, 19	3.19	13 00	.....
Shreveport	24	2.92	23 30	.....
Michigan.				
Gaylord	3, 4	2.30	.....	6.88
Do	23, 24	3.00	.....	.....
Sault St. Mary	.....	.....	.....	6.81
Harrisville	23	2.14	7 00	.....
Mississippi.				
Natchez	17 to 19	10.43	.....	12.43
Hazelhurst	17, 18	10.00	.....	10.20
Lake	17 to 19	6.86	.....	6.86
Okolona	24, 25	2.75	.....	.....
Batesville	24	2.31	.....	.....
Meridian	17 to 19	3.70	.....	.....
Waynesborough	17 to 19	2.56	.....	.....
Macon	17 to 19	2.98	.....	.....
Brookhaven	17 to 19	4.20	.....	.....
Edwards	17 to 19	3.27	.....	.....
Unive'ty of Miss	24	2.67	19 00	.....
New Jersey.				
Egg Harbor City	20, 21	2.22	3 50	.....
Roseland	20	2.35	.....	.....
Atlantic City	20, 21	2.32	16 40	.....
Bordentown	21	2.00	.....	.....
Hopewell	21	2.00	.....	.....
Imlaystown	21	2.05	.....	.....
Lakewood	21	2.86	.....	.....
Oceanic	21	3.52	.....	.....
Toms River	21	2.45	.....	.....
New York.				
Boyd's Corners	20, 21	2.13	.....	.....
North Carolina.				
Salisbury	18 to 20	4.28	.....	14.19
Do	24 to 30	9.84	.....	.....
Chapel Hill	18 to 20	2.86	33 00	11.21
Do	24 to 31	8.20	172 15	.....
Hatteras	30, 31	3.94	16 45	11.07
Raleigh *a*	31	4.18	*24 00	10.23
Weldon	30, 31	3.41	13 55	9.97
Raleigh *b*	.....	.....	.....	9.80
Lumberton	18 to 20	5.10	.....	9.51
Do	26 to 28	3.13	.....	.....
Weldon	18 to 20	2.46	.....	8.45
Do	24 to 31	5.18	.....	.....
Charlotte	30, 31	2.49	24 00	8.04
Wadesborough	18 to 20	2.09	.....	6.64
Do	30, 31	2.35	.....	.....
Wilmington	.....	.....	.....	6.53
Statesville	30, 31	2.07	12 30	6.51
Charleston	25	2.15	.....	.....
Goldsborough	31	2.75	.....	.....
Pennsylvania.				
Fallsington	20	2.33	.....	.....
Corry	4, 5	2.31	.....	.....
South Carolina.				
Cheraw	18 to 21	4.00	.....	10.11
Do	25 to 31	6.11	.....	.....

Table of excessive and greatest monthly precipitation—Continued.

Station.	Specially heavy. Date.	Amount.	Duration.	Largest monthly. Am't.
S. Carolina—Con.			*h. m.*	
Blackville	20	2.34	.....	8.61
Do	26	2.25	.....	.....
Stateburg	17, 18	2.50	16 30	8.15
Florence	18 to 20	4.22	.....	8.09
Columbia	17, 18	2.77	13 53	7.43
Kirkwood	17	2.54	.....	7.23
Allendale	20	3.35	.....	6.76
Do	26 to 28	2.99	.....	.....
Batesburg	26 to 28	3.31	.....	6.51
Saint Matthew's	20	2.68	.....	6.28
Branchville	27	2.00	.....	.....
Tennessee.				
Grand Junction	24, 25	2.07	.....	.....
Texas.				
Brownsville	10, 11	6.09	13 24	16.27
Austin	8, 9	2.78	.....	.....
Orange	26, 27	3.99	.....	.....
Weatherford	8, 9	3.08	.....	.....
Texas—Con.			*h. m.*	
Sour Lake	18	2.40	.....	.....
Longview	24	2.60	.....	.....
Huntsville	8	2.05	.....	.....
Do	24	2.00	.....	.....
Corsicana	8	2.50	.....	.....
Brenham	24	2.75	.....	.....
Abilene	7, 8	2.39	*24 00	.....
Palestine	24	2.60	15 38	.....
Virginia.				
Fort Monroe	29 to 31	3.36	.....	8.11
Cape Henry	31	2.00	.....	6.43
Norfolk	.....	.....	.....	6.38
Bird's Nest	.....	.....	.....	6.35
Rappahannock	3	2.42	10 05	6.22
Washington.				
Neah Bay	27	5.77	24 00	14.84
Tatoosh Island	27, 28	4.59	20 00	11.83
Pysht	26, 27	2.33	.....	.....

*Less than twenty-four hours.

DROUGHT.

For the purpose of showing the excess or deficiency of rainfall for the first ten months of the year in the various districts of the country, the following table has been prepared:

Precipitation for January to October—Signal Service observations.

Districts.	Normal.	Average for 1887.	Comparison of 1887 with the normal.	Percentage of normal rainfall for the months of 1887.
	Inches.	*Inches.*	*Inches.*	*Per cent.*
New England	39.73	38.10	— 1.63	96
Middle Atlantic states	36.62	36.59	— 0.03	100
South Atlantic states	48.83	42.63	— 6.20	87
Florida Peninsula	45.22	39.55	— 5.67	87
East Gulf states	50.54	43.62	— 6.92	86
West Gulf states	38.45	28.79	— 9.66	75
Lower Rio Grande valley	25.18	39.62	+14.44	157
Ohio Valley and Tennessee	38.41	36.36	— 2.05	95
Lower lake region	31.15	25.63	— 5.52	83
Upper lake region	29.86	22.78	— 7.08	76
Extreme northwest	17.96	16.61	— 1.35	92
Upper Mississippi valley	33.17	23.15	—10.02	67
Missouri Valley	27.02	23.10	— 3.92	86
Northern slope	16.95	18.68	+ 1.73	110
Middle slope	19.57	19.70	+ 0.13	101
Southern slope	20.57	21.62	+ 1.05	105
Southern plateau	10.58	11.13	+ 0.55	105
Middle plateau	10.96	8.61	— 2.35	79
Northern plateau	13.76	12.71	— 1.05	92
North Pacific coast region	35.85	42.41	+ 6.56	118
Middle Pacific coast region	16.81	11.76	— 5.05	70
South Pacific coast region	8.75	7.68	— 1.07	88

From the above table it will be seen that east of the Rocky Mountains the greatest percentage of deficiency in the rainfall for the first ten months of the year occurs in the upper Mississippi valley—the west Gulf states and upper lake region following next in order. In the lower Rio Grande valley more than double the average is shown.

The very serious drought which prevailed from May to September in Michigan, Wisconsin, Iowa, Ohio, Indiana, Illinois, Kentucky, and Missouri was slightly ameliorated in northern Wisconsin during October, but the condition of affairs at the end of the month was still serious, as appears from extracts elsewhere. The commencement of this drought was in April last, during which month less than 50 per cent. of the average precipitation fell in southern Michigan and Wisconsin, northern Illinois, the southwestern part of Iowa, and the northwestern part of Missouri.

During May a precipitation slightly above the average fell over a belt of country about sixty miles wide, extending from Cincinnati, Ohio, and Frankfort, Ky., westward to Indiana and Illinois, including the immediate valley of the Missouri River as far as Jefferson City; elsewhere in the states previously named, the precipitation was largely deficient, especially in Iowa, Illinois, and the northern half of Michigan, where the percentage ranged from 20 to 50 of the average rainfall.

In June the area over which less than half the usual rain fell comprised Iowa, Illinois, southern Wisconsin, southwestern Michigan, and northwestern Indiana. Throughout the section named only from one-tenth to one-fifth of the usual rainfall for June occurred in many places.

During July a slight excess of rainfall fell over the northern half of the lower peninsula of Michigan and central Wisconsin, but throughout the rest of the drought-stricken states, the precipitation generally ranged from 50 to 80 per cent. of the average, except in Ohio, southern Indiana, southeastern Illi-

nois, and the western parts of Iowa and Missouri, where the amount of rain in some cases was only from 15 to 30 per cent. of the mean.

During August slight excesses fell in western Iowa, western Wisconsin, and the northern part of Illinois: throughout the rest of the drought district the rainfall was generally from one-half to three-fourths of the average, but in the greater part of Michigan, as well as in the southern part of Illinois, the amount was less than one-half the mean.

In September the greater part of Iowa, Wisconsin, and northern Illinois, and the extreme southern part of Michigan, was relieved by rainfall slightly in excess of the average, but the remaining states still suffered from a deficiency for the month, which in the northern part of Michigan ranged from one-sixth to one-half the usual amount.

The condition of affairs has improved materially in Wisconsin during October, where a slight excess of precipitation has fallen. In Michigan, Iowa, the greater part of Illinois, and Indiana the drought is aggravated, as the precipitation has only been from one-third to three-fourths of the usual amount, while in the valley of the Ohio and of the Mississippi, from Cairo to Quincy, the amount of rainfall has been exceedingly small, not averaging more than 20 per cent. for that district, and ranging from 10 to 30 per cent.

During the six months from May to October, inclusive, the rainfall has been largely deficient over Minnesota, Wisconsin, Michigan, Iowa, Missouri, Indiana, Illinois, Kentucky, and parts of Minnesota and Dakota, and eastern Nebraska and southeastern Kansas. Less than one-half the usual amount of rainfall during these months has fallen in central Ohio and at certain points on the immediate banks of the Ohio River, from Louisville to Cairo, inclusive. Similar local deficiencies, averaging more than 50 per cent., occurred near Springfield, Ill., Webster, Dak., and La Crosse, Wis. Less than three-fourths of the average amount of rain has fallen during these five months from Michigan, Ohio, and Kentucky westward to include Misssouri and Iowa.

The percentages of rainfall which have occurred at different points are shown in the following tables:

Table showing distribution of precipitation during drought of 1887. The values are in percentages of the average rainfall for each month and for the entire period from May to October, inclusive.

Station.	May.	June.	July.	Aug.	Sept.	Oct.	For six months
Ohio.							
Cleveland	109	60	25	107	96	63	74
Sandusky	50	95	18	42	70	34	54
Columbus	61	76	42	61	56	10	52
Cincinnati	101	59	35	71	86	21	62
Toledo	44	91	90	62	119	66	79
Jacksonburg	62	70	15	50	57	16	45
North Lewisburg	116	66	44	83	65	20	68
Portsmouth	50	94	99	51	70	30	68
Ruggles	90	85	60	129	60	30	66
Wauseon	162	83	71	50	71	62	87
Westerville	52	74	.....	.....	.....	.....	.....
Marietta	75	112	25	65	74	.....	.....
Indiana.							
Indianapolis	58	47	28	90	72	18	51
Laconia	57	71	17	24	81	12	47
Lafayette	41	35	25	109	.....	.....	.....
Logansport	81	70	64	100	81	70	80
Vevay	116	39	56	62	99	25	65
Michigan.							
Port Huron	70	68	53	68	95	48	66
Detroit	61	113	35	80	158	58	83
Alpena	73	59	150	31	49	88	74
Mackinaw	67	50	86	12	79	58	59
Grand Haven	88	13	92	61	102	72	74
Escanaba	21	52	125	36	28	82	55
Marquette	38	79	87	93	24	67	62
Brady, Fort	41	60	188	25	41	107	73
Lansing	50	27	46	25	178	60	59
Traverse City	25	120	84	40	17	99	63
Illinois.							
Chicago	40	41	30	100	130	59	64
Cairo	35	53	38	41	63	13	41
Springfield	41	54	48	37	76	22	47
Aurora	67	16	72	101	155	84	80
Collinsville	170	39	106	38	60	18	62
Golconda	50	48	29	57	148	16	55
Greenville	.....	42	47	32	81	21	.....
Griggsville	73	.....	150	24	121	12	.....
McLeansborough	77	64	139	5	44	18	57
Marengo	29	30	79	134	120	106	82
Mattoon	99	19	46	89	95	126	79
Palestine	124	28	40	85	65	27	63
Pana	155	31	67	125	106	30	83
Peoria	33	38	73	86	73	80	62
Rockford	55	20	77	141	139	60	76
Sandwich	48	42	131	116	113	88	87
Sycamore	23	17	60	96	86	53	52
Kentucky.							
Louisville	55	42	46	78	98	13	54
Frankfort	110	56	97	95	149	28	89
Missouri.							
Saint Louis	130	51	71	47	71	27	64
Lamar	71	151	125	76	52	100	91
Kansas.							
Leavenworth	63	98	30	205	159	115	100
Dodge City	93	124	30	72	11	40	71
Concordia (2 years)	138	125	66	149	99	61	110
Hays, Fort	94	127	26	160	125	155	103
Independence	84	73	78	116	106	84	89
Riley, Fort	103	90	60	193	170	114	115
Salina	98	117	42	264	269	28	101
Wellington	63	52	82	211	58	29	73
Yate's Centre	49	107	99	99	90	49	80
Manhattan	60	111	24	199	194	124	109
Lawrence	24	.....	.....	174	170	124	.....

Table showing distribution of precipitation during drought, etc.—Continued.

Station.	May.	June.	July.	Aug.	Sept.	Oct.	For six months
Nebraska.							
Omaha	29	75	36	111	69	25	57
North Platte	27	92	109	175	313	13	122
Crete	143	106	42	166	131	37	100
Valentine (2 years)	89	127	111	122	86	97	108
De Soto	34	110	27	94	78	64	67
Fremont	63	49	96	91	65	60	71
Niobrara	64	79	72	194	98	31	81
Robinson, Fort	143	30	101	187	11	768	170
Genoa	39	140	125	206	398	.....	.....
Iowa.							
Davenport	43	38	87	78	159	109	82
Dubuque	66	26	50	120	155	71	81
Keokuk	64	30	38	74	86	58	56
Des Moines	46	34	53	76	132	34	59
Cresco	26	41	67	77	176	60	77
Independence	26	38	84	74	253	39	91
Logan	30	54	45	124	114	38	66
Muscatine	50	48	71	52	90	70	63
Wisconsin.							
Milwaukee	55	21	156	74	138	89	86
La Crosse	17	23	37	65	88	66	47
Beloit	30	11	45	163	162	76	79
Embarras	70	100	99	132	127	120	112
Madison	63	32	118	106	186	98	98
Manitowoc	43	34	50	78	163	123	78
Wausau	97	42	.....	.....	.....	.....	.....
Minnesota.							
Duluth	129	52	107	46	61	112	82
Saint Paul	49	60	118	92	126	73	86
Moorhead	87	86	132	46	14	54	79
Saint Vincent	148	148	148	66	21	7	94
Minneapolis	77	70	119	111	113	116	98
Snelling, Fort	65	132	99	155	97	73	107
Dakota.							
Yankton	30	53	131	142	211	46	100
Huron	42	97	112	163	9	46	95
Bismarck	77	27	183	64	108	97	87
Sully, Fort	52	83	119	151	33	121	94
Deadwood	91	58	147	147	184	132	110
Buford, Fort	84	111	88	268	142	144	128
Fort Abraham Lincoln	47	34	225	55	146	44	80
Meade, Fort	65	67	269	235	379	49	129
Pembina	56	195	143	38	38	12	88
Randall, Fort	11	27	113	132	99	27	54
Richardton	113	54	.....	83	.....	126	—
Sisseton, Fort	69	187	176	284	70	52	154
Webster	28	43	73	90	25	29	46
Yates, Fort	182	48	109	74	366	190	119
Totten, Fort	87	156	122	104	81	105	119

Unless an excess of rainfall occurs during November these states must suffer owing to the small amount of water which fell during the first of the season, as streams and wells must fail and the ground itself be in such a dry condition as to interfere more or less materially with the winter wheat of the early spring crops.

The following notes on drought have been received:

Wash Woods, N. C., 9th: rain is much needed in this locality; wells are drying up, cisterns have long been exhausted, and cattle are suffering for water. There is a great deal of sickness prevailing in this locality, which is attributed to the long and severe drought. Rain amounting to one-half inch fell on the 10th.

University of Virginia, Va., 14th: weather very dry and many cisterns exhausted, but the season is favorable for cotton harvest. The first rain of the month fell on the 17th.

Huntington, Huntington Co., Ind., 15th: a severe drought is prevailing in this locality; farmers are compelled to go great distances for water both for cattle and domestic use.

Parkston, Hutchison Co., Dak., 31st: the precipitation of the month, 0.15, is unusually small, and the ground is very dry.

Mottville, Saint Joseph Co., Mich., 31st: streams and wells continue low, not sufficient rain to be of benefit.

Fayette, Howard Co., Mo., 31st: the water in creeks and ponds is very low, and if rain does not fall before the winter sets in water for stock will be scarce in many places.

Charleston, Coles Co., Ill., 31st: creeks are all dry, and stock is suffering for water.

Cairo, Ill., 31st: the total precipitation for the month, 0.38, is the least amount recorded in October since the establishment of the Signal Service station in 1871; the fall sown cereals and late crops are suffering in consequence.

Garrettsville, Portage Co., Ohio, 31st: most of the brooks and swamps are dry and water in wells is at a lower stage than at any previous time this year.

Elyria, Lorain Co., Ohio, 31st: the severe drought which has prevailed in this section since last June still continues, and its effects are becoming more alarming. Streams all dry,

many wells have failed, and farmers have to haul water for stock.

Ruggles, Ashland Co., Ohio, 31st: very dry and water scarce.

Tiffin, Seneca Co., 31st: water has become scarce in this section of the state as a result of the continued dry weather.

West Milton, Miami Co., Ohio, 31st: on account of the long continued drought there is in some localities a great scarcity of water; wheat is suffering in consequence of drought.

Strafford, Orange Co., Vt., 31st: springs are low and fall pasturage has suffered in consequence of the dry weather.

The October report of the "Indiana Weather Service" states:

The total deficiency in precipitation during the month was 2.74 inches and since January 1, 1887, 13.21 inches. So great a deficiency, extending over so many months preceding October, surpasses any former droughts on record. From every part of the state, especially from the southern and central sections, reports have been received as to scarcity of water, and the evils consequent on such protracted drought are felt in many localities. Creeks and surface wells have become dry; wheat either has not come up at all or has turned yellow in many fields, and cattle are suffering from want of water, which has to be brought to many farms from great distances. The observer at Vevay reports that the Ohio River has been lower than noted for many years.

SLEET.

Sleet fell at scattering stations, mostly in the Northern States and territories, during the month on the following dates: 1st, 7th, 10th to 12th, 14th, 20th to 25th, 29th, 30th.

SNOW.

Reports show that snow fell in some part of the country on every day during the month, with the exception of the 1st, 2d, and 27th. The snowfalls were, in general, light and, in many instances, local. From the 20th to 25th snow was of more general occurrence than during any other period of the month; on the 21st, 22d, and 23d it was reported from nearly all stations in the Lake region, and at many in the extreme northwest, New England, and the middle Atlantic states.

MONTHLY SNOWFALLS (in inches and tenths).

The following stations report monthly snowfalls of one inch or more:

Colorado.—Denver, 3.1. *Dakota.*—Deadwood, 13.1; Fort Buford, 11.5; Richardton, 2.8; Fort Totten, 1. *Iowa.*—Bancroft, 5. *Michigan.*—Marquette, 10.8; Alpena, Escanaba, and Harrisville, 1.5. *Minnesota.*—Minneapolis, 2. *Montana.*—Fort Maginnis, 20.2; Helena, 8.3; Poplar River, 7.8; Fort Custer, 1.1. *Nebraska.*—Hay Springs, 3; Valentine, 1.7; North Platte, 1.1. *North Carolina.*—Marion, 2. *Ohio.*—Garrettsville, 2.5; Cleveland, 1.4. *Pennsylvania.*—Erie, 3.5; Corry, 3; Washingtonville, 2; Wellsborough, 1.1. *Utah.*—Frisco, 4.2. *Virginia.*—Marion, 5 to 6; Wytheville, 1. *Wisconsin.*—Green Bay, 10.1; La Crosse, 2.5. *Wyoming.*—Cheyenne, 4.5; Fort Bridger, 2.

The only station reporting snow on the ground at end of month is Marquette, Mich.; depth, one inch.

HAIL.

Hail is reported to have fallen in various parts of the country from the 2d to 5th, 10th, 11th, 13th to 21st, 23d to 25th, 29th to 31st; it was most numerously reported on the 11th and from the 21st to 25th.

WINDS.

The most frequent directions of the wind during October, 1887, are shown on chart ii, by arrows flying with the wind. In the northern districts from the Rocky Mountains eastward to the Atlantic coast the prevailing winds are generally from southwest, west, or northwest; in the Southern States, northwest, north, or northeast; in the Rocky Mountain and Pacific coast districts, variable.

HIGH WINDS (in miles per hour).

The maximum velocities of the wind for October, 1887, at Signal Service stations where the movements are registered, are given in the table of miscellaneous meteorological data. But one station reports a velocity exceeding 50 miles per hour other than the maximum for the month, viz., Buffalo, N. Y., 60 miles, sw., on the 3d and 4th.

LOCAL STORMS.

La Crosse, Wis.: a severe thunder-storm occurred at this place from 12 to 1 a. m. on the 7th; hail, accompanied by light rain, fell for about twenty minutes, the hail-stones were quite large, some measuring two by one and one-half inches, but most of them were of the size of marbles.

Wellington, Sumner Co., Kans.: unusually heavy showers prevailed from 2.30 p. m. on the 7th until 10.30 a. m. on the 8th, 6.02 inches of rain having fallen in twenty hours. Much benefit has been derived from this rain; the fall-sown wheat was placed in good condition.

Key West, Fla.: a gale prevailed from 9.45 a. m. until 3 p. m. on the 8th, reaching a maximum velocity of thirty miles per hour at 12.25 p. m., and continuing at that rate until 1 p. m. Heavy rain fell from between 7 and 8 p. m. until after midnight, flooding the streets.

Riverside, San Bernardino Co., Cal.: on the 11th, at 12.45 p. m., a rain storm, accompained by hail and light thunder. At 12.40 p. m. clouds from two directions appeared to meet in the southeast with a loud, rushing noise, similar to the approach of a tornado. The track of the storm was about four miles wide, coming from the southeast, although the track of the heaviest hail was not more than a mile in width. The hail-stones were from an inch and a quarter in diameter down.

New Orleans, La.: a wind storm began 9.52 p. m. on the 11th and ended 9.04 a. m. the following day; maximum velocity, thirty miles per hour, from the north.

Brownvsille, Tex.: fresh to brisk northerly winds and heavy rain began during early a. m. and ended 11.20 a. m. on the 11th, 5.60 inches of rain falling during the storm. The Rio Grande River overflowed, but fell rapidly during the 12th. Heavy rain began 1.45 p. m. on the 21st, changing to light rain 3.50 p. m. and ending 9.10 p. m. The rain during the first two hours was very heavy, 2.48 inches having fallen from 1.45 to 3 p. m.; the streets were flooded to a considerable extent.

Wood's Holl, Mass.: a storm began 10.40 a. m. and ended 12.40 p. m. on the 13th; maximum velocity, forty-two miles, from the southwest, occurred 2.55 p. m.

Titusville, Fla.: light and heavy rains prevailed during the 16th; total precipitation 3.33 inches; the rain was accompanied by high winds, reaching a velocity of thirty-eight miles per hour. The railroad bridge over Deep Creek, about twenty miles northeast of this place, was seriously damaged by the flood which resulted from the heavy rain, and the railroad track near the bridge was washed out about one-half mile.

Galveston, Tex.: a gale began 4.20 a. m. on the 18th, reaching a velocity of forty-eight miles per hour at 5 p. m.

Valentine, Nebr.: a gale began 8.35 a. m. on the 19th and continued until 6.40 p. m. on the 20th; maximum wind-velocity, fifty-four miles per hour from the north, occurred on the 19th.

WATER-SPOUT.

Capt. A. McDougall, of the s. s. "Caspian," reports: "October 6th, in N. 39° 32′, W. 69° 10′, at 10.35 a. m., wind n. by w., force 6, barometer 29.80; vivid lightning to se. and nw., with very loud peals of thunder; a very black squall made up